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REPORT

OF THE

UNITED STATES COMMISSIONER OF FISHERIES

FOR THE FISCAL YEAR 1939

WITH

APPENDIXES

CHARLES E. JACKSON
ACTING COMMISSIONER

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NOTE

The first section of this volume, entitled "Bureau of Fisheries," constitutes what was known in years prior to 1933 as "Report of the Commissioner of Fisheries." Since then, in the interests of economy, it is a reprint from the "Annual Report of the Secretary of Commerce." The pagination, therefore, is the same as that of the Secretary's Report, rather than beginning with page 1.

This report covers two administrations of the Bureau of Fisheries. Commissioner Frank T. Bell resigned, effective March 21, 1939, and the duties of that office were assumed by Charles E. Jackson, as Acting Commissioner, on that date.

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U. S. DEPARTMENT OF COMMERCE

BUREAU OF FISHERIES

HEADQUARTERS STAFF, 1938-39

Acting Commissioner

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[Reprint from the Annual Report of the Secretary of Commerce, 1939]

BUREAU OF FISHERIES

Available statistics indicate that there was a decrease in the volume but an increase in the value of fishery products taken in the United States and Alaska during 1937 as compared with the preceding year. Data on the catch were collected for both 1936 and 1937 in the Chesapeake, South Atlantic and Gulf, Pacific, and Lake States and in Alaska. The combined catch in these sections alone shows a decrease of 13 percent in volume but an increase of 7 percent in value. Decreased catches were made in each of the five geographical sections; however, the principal reductions occurred in the Pacific Coast States where greatly reduced catches of pilchards were taken, and in Alaska where there was a large decline in the catch of salmon.

The total catch of fishery products in the United States and Alaska, as based on the most recent surveys, amounted to 4,352,549,000 pounds, valued at $100,845,000. About 130,000 fishermen were employed in making this catch.

The production of canned fishery products in the United States and Alaska during 1937 amounted to 742,197,000 pounds, valued at $105,175,000; the output of byproducts was valued at $36,804,000; the production of frozen fishery products, excluding packaged products, amounted to 103,112,000 pounds, estimated to be valued at $8,800,000; and fresh and frozen packaged fish and shellfish, 201,803,000 pounds, valued at $27,678,000. Based on surveys for previous years, the production of cured fishery products amounted to 104,339,000 pounds, valued at $15,635,000. It is estimated that about 686,000,000 pounds of fresh fishery products (excluding packaged fish and shellfish), valued at about $57,000,000, was marketed during 1937. The total marketed value to domestic primary handlers of all fishery products in 1937 is estimated at $251,000,000.

Fishery products imported for consumption were valued at $50,636,000 and domestic exports were valued at $14,567,000.

The value of the production of canned fishery products in all sections increased 11 percent as compared with 1936; byproducts increased 5 percent; frozen fish, about 1 percent; and packaged fish, 3 percent.

INTERNATIONAL RELATIONS

HALIBUT INVESTIGATIONS

The International Fisheries Commission continued the investigation and regulation of the Pacific halibut fishery, under authority of the treaty of Jauary 29, 1937, between the United States and Canada.

In fulfillment of its regulatory duties, the Commission recorded the catch from each regulatory area, forecast and announced the date

of attainment of each area limit, and closed the areas accordingly. It opened the 1939 fishing season on April 1 under regulations essentially unchanged from those of the preceding year.

Areas 1 and 2 were closed to halibut fishing in 1938 at midnight of July 29, with catches of approximately 706,000 and 22,923,000 pounds, respectively. Areas 3 and 4 were closed at midnight of October 29, with catches of 25,591,000 and 0 pounds, respectively.

The investigations of the Commission's scientific staff were continued along the lines necessary for fulfillment of the purpose of the treaty. Current biological and statistical data, which form a system of observation of the changes occurring in the stocks of halibut as a result of regulation and a necessary basis for the continued rational control of the fishery, were collected and analyzed. The collection of biological data made necessary the operation of a vessel at sea.

The abundance of halibut, as indicated by the catch per unit of fishing effort, showed a further increase all along the coast in 1938. In area 2, between Cape Spencer in Alaska and Willipa Bay in Washington, the abundance was 15 percent greater than in 1937, 100 percent greater than in 1930. In area 3, between Cape Spencer and the Aleutian Islands, it was 3.5 percent greater than the previous year and 77 percent greater than in 1930, the last year of unrestricted fishing.

Sampling of the stocks of marketable halibut by means of market measurements was continued to determine the changes occurring in their composition as a result of regulation. For the first time since the Commission began regulating the fishery, market measurements failed to show an increase in the size of the fish landed or in the proportion of mature fish on the more depleted banks of area 2. The maximum proportion of larger sizes from the stock of young available at the time regulation began appears to have been reached and a further increase in the larger sizes may not occur until the increasing stock of young has had time to grow up.

Observation of the effect of regulation on the production of spawn in area 2 was continued by means of net hauls taken at sea during the winter spawning season. Analysis of the catches of eggs indicated that the increase observed in their abundance from 1934–35 to 1936–37 was not continued in 1937–38 and 1938–39. No special significance can yet be attributed to the failure of production in the latter 2 years to equal the high level of 1936–37, because of the variations that occur normally from year to year among marine species, but it is to be suspected that it may be associated with the changes in size composition mentioned above.

INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION

Work of an experimental and preliminary nature, to establish facts upon which the permanent program could be based, was carried on during the 1938 season. A compilation and analysis of the great mass of existing records of the sockeye run to the Fraser River was nearing completion by the end of the year. A survey of the spawning grounds was begun. The adult migrants in salt water were tagged and extensive recoveries made on the spawning grounds.

The Commission held its third meeting September 23–24 in Vancouver, B. C. The program of investigation, then under way, was discussed and that for 1939 approved. In February 1939, William A. Found resigned and was replaced by A. J. Whitmore.

JAPANESE ACTIVITIES IN THE BRISTOL BAY FISHERY

Japanese fishery operations in Bristol Bay in 1939, the tenth consecutive season in which such activities have been carried on, were confined to the catching and canning of king or spider crabs, and only one floating cannery, together with auxiliary craft, was employed. This indicates a continued adherence on the part of the Japanese Government to the assurance given in the spring of 1938 that its official survey of the salmon in Bristol Bay would be suspended and that it would issue no license to vessels to take salmon in those waters.

CONSERVATION OF WHALES

The Protocol of June 24, 1938, which amends in certain particulars the International Agreement for the Regulation of Whaling, signed at London on June 8, 1937, came into force as to the United States on March 30, 1939, and was proclaimed by the President on April 8, 1939.

The principal provisions of the Protocol of 1938, which are advances in the measures of conservation of the whale stock of the world provided in the agreement of 1937, are as follows:

(1) A prohibition against the taking or treating of humpback whales south of 40° south latitude by factory ships or whale catchers attached thereto from October 1, 1938, to September 30, 1939. (Article 1.)

(2) The establishment of a sanctuary for baleen whales south of 40° south latitude between 70° west longitude and 160° west longitude for a period of 2 years from December 3, 1938. (Article 2.)

(3) A clarification of provisions in articles 7 and 8 of the agreement of 1937, which had given rise to conflicting interpretations, so as to make clear that no factory ship which has been used for the purpose of treating baleen whales south of 40° south latitude shall be used for that purpose elsewhere within 12 months from the end of the open season; that only factory ships which have operated within the territorial waters in 1937 shall so operate after the signature of the protocol; that such ships shall be treated as land stations, shall remain moored, and shall not operate more than 6 months in any 12-month period; and that such operations shall be continuous. (Article 3.)

NORTH AMERICAN COUNCIL ON FISHERY INVESTIGATIONS

The twenty-fifth meeting of the North American Council on Fishery Investigations was held in Boston, Mass., October 4–7, 1938. Representatives from Canada, Newfoundland, and the United States were present. At the invitation of the Council, members of the Fishery Advisory Committee of the Department of Commerce and other leaders of the fishing industry attended a general session on

October 5 for a discussion of fishery problems in the North Atlantic area. The general program of fishery investigations being conducted by Canada, Newfoundland, and the United States was presented.

In the sectional committee meetings dealing with groundfish investigations, shorefish studies, hydrographic research, and fishery statistics, nearly a score of investigators presented reports on their work, affording members of the Council a summary review of progress during the year in these fields and permitting them to modify their official program accordingly. Important advances were reported in the study of the cod fishery being prosecuted by Canada, the lobster studies in Newfoundland, and the investigations in the United States leading to a proposal for effective management of the haddock fishery.

INTERSTATE COOPERATION IN FISHERY MANAGEMENT

As a result of efforts of the Council of State Governments in cooperation with the Bureau of Fisheries and with fishery administrators of the various States concerned, progress has been made toward the solution of fishery problems in the Great Lakes and on the Atlantic coast.

The Interstate Committee on Great Lakes Fisheries, appointed at the conference held under the auspices of the Council of State Governments in February 1938, met in Chicago on December 5. An international treaty to bring about uniform regulation of Great Lakes fisheries was again endorsed. Pending the adoption of an international treaty, however, the Committee recommended the adoption of an interstate compact for the regulation of United States fisheries in the Great Lakes. The formation of such a compact has been authorized by the Congress of the United States. The Committee also urged that State fish and game commissioners be given discretionary power to regulate fisheries without legislative action.

At the Eastern States Conservation Conference held in New York November 19, a resolution was unanimously adopted petitioning Congress to grant permission to States bordering on the Atlantic coast to enter into a compact for the protection of migratory fishes in territorial waters. A committee was appointed to prepare a draft of the compact for submission to the States.

FISHERY ADVISORY COMMITTEE

The Fishery Advisory Committee met in Boston, Mass., on October 5, 1938, in conjunction with the National Fisheries Convention in session during the week. Discussion centered largely around problems of production and merchandizing fishery products. On October 5, members also attended a general session of the North American Council on Fishery Investigations for consideration of fishery problems in the North Atlantic area.

The Committee met in Washington, D. C., January 30–31, 1939. Special problems challenging the industry at this time, recommended by the Committee for further research, are improvements in methods of transporting iced and frozen fishes and more complete utilization of the waste products of the fisheries. Inasmuch as fishery products constitute a wholesome and nutritious food which contains mineral

elements essential to health that are not readily available in many foods of land origin, an even flow of fishery products from producer to consumer is essential to the public interest.

DOMESTIC RELATIONS

COOPERATION WITH FEDERAL, STATE, AND OTHER AGENCIES

Cooperation was given by members of the Bureau technological staff to chemists and bacteriologists of the Food and Drug Administration, U. S. Department of Agriculture, in connection with the development and application of tests on methods of determining the quality and constituents of various fishery products; and to the Extension Service of the U. S. Department of Agriculture in connection with the conduct of demonstrations and practical instruction on the preservation of fishery products and more complete utilization in the diet of the excellent food value of fish and shellfish.

Members of the economic and marketing staff of the Division of Fishery Industries cooperated with the Department of Labor in holding conferences with fishermen's unions and associations to settle disputes. The Division also worked with various Federal agencies in obtaining statistical data on our fisheries. These included the Bureau of Agricultural Economics, the health authorities in Washington, D. C., and the Bureau of the Census.

The Bureau has carried on cooperative investigations in technological work with several colleges, universities, and other State institutions. Outstanding among these are Washington State College, Pullman, Wash.; University of Washington, Seattle, Wash.; University of Maryland and Maryland State Agricultural Experiment Station, College Park, Md.

In the conduct of its statistical and marketing work some form of cooperation is given the Bureau in virtually every State where commercial fishing is prosecuted. This cooperation probably reached its greatest development in the States bordering on the Great Lakes and in the Pacific Coast and Chesapeake Bay States.

The Division of Fish Culture maintains the closest liaison with the State fish and game departments and other Federal agencies concerned with the conservation of fish. There has been close contact between the Bureau's representatives, the Bureau of Reclamation, and fisheries officials of the State of Washington with reference to the development of plans for the artificial propagation of the salmon run to be affected by the completion of the huge Grand Coulee Dam.

There has been continued expansion of the policy of routing fish applications to the State departments for check and approval before deliveries are made. The natural consequence of this has been a development of arrangements for the States to deliver the fish with their own equipment and this has been practiced in a number of instances.

The exchange of eggs and fish by the Bureau has been of mutual benefit, particularly in Michigan and Minnesota. In the Western States also, particularly in Oregon, the fish-cultural and fish-distribution work is closely coordinated, with resultant economies to both the State and the Federal Governments.

In the Tennessee Valley area, three-way agreements between the Bureau of Fisheries, the Tennessee Valley Authority, and the States of Alabama, Tennessee, and North Carolina have been made effective or are being negotiated. Under such agreements the T. V. A. has established and built hatcheries and rearing facilities which the Bureau is to operate. The fish produced are to be distributed by the States in that part of the Tennessee Valley area which are included within the respective State boundaries.

The work with the National Park Service has continued in a constructive way and at the close of the year the Park Service was constructing a new hatchery at Glacier Park with subsequent operations to be managed by the Bureau.

In view of the tremendous responsibility upon the Forest Service of the Department of Agriculture for the maintenance of fishing in the national forests, the Bureau has enjoyed unusual cooperation with that agency. A new trout-rearing unit was under construction in the Allegheny National Forest in Pennsylvania, under plans developed and approved by the Bureau with the expectation that it would be operated by this Bureau upon completion.

The State of North Dakota Fish and Game Department donated the site for a new hatchery at Valley City. At St. Louis, Mo., the city officials have approved the construction, at no cost to the Bureau, of a modern hatchery and service building in the Forest Park hatchery. This series of ponds was taken over by the Bureau for operation shortly before the start of the fiscal year 1939 and the results have been most favorable. The State of Minnesota donated a tract of land for a hatchery at New London and furnished the services of surveyors and engineers in acquiring additional property. The site for a new hatchery, at Farlington, Kans., was more easily acquired by reason of the donation of water rights to a State-owned lake. The State of Ohio purchased and donated to the Bureau a splendid location for the new hatchery to be constructed in that State.

CONSTRUCTION ACTIVITIES

At the start of the fiscal year there was being undertaken an extensive program of hatchery development and improvement financed by an allocation of $808,500 from the Public Works Administration, and $500,050 from the Works Progress Administration.

These funds were allocated to more than 70 different field projects, involving complete rehabilitation of some of the older hatcheries and enlargement and improvement of the newer establishments. The work involved replacement of pipe lines or complete construction of new water-supply systems; construction, repair, and improvement of buildings; construction of ponds; installation of new equipment; and general landscaping. In some instances there was a 100-percent increase in the productive capacity of a station. The Public Works Administration funds were largely used for the purchase of materials, supplies, and equipment; while the labor, practically all from relief sources, was a contribution from the Works Progress Administration allotment.

The principal development of an entirely new nature was the construction of a pondfish hatchery at the Roy Inks Dam on the lower

Colorado River in Texas. The site was furnished by the Lower Colorado River Authority and the construction was supervised by the Bureau. It was financed by a portion of the P. W. A. allotment and by the assignment of N. Y. A. labor. At the close of the year this project was virtually completed and some of the ponds were stocked with fingerling bass.

Great improvements were effected at the Fort Worth station, where an additional tract of land was donated by the city of Fort Worth and utilized for the development of additional ponds.

The Charlevoix, Mich., hatchery, which had been closed since 1933, was entirely rehabilitated and equipped for the rearing of lake trout fingerling.

In several instances the State W. P. A. projects were in effect, also making possible additional improvements. An outstanding example of this method was at Guttenberg, Iowa, where initial work on a very large bass and pondfish hatchery within the Upper Mississippi River Wild Life and Fish Refuge was undertaken. Curtailment of the scope of the C. C. C. resulted in some restriction of the construction work prosecuted by this agency. A limited number of assignees were held at work at Lamar, Pa., but the C. C. C. development at the York Pond, N. H., station was terminated. However, it was possible to continue developments there by utilization of emergency funds allotted directly to the Bureau.

In addition to the improvements made possible by direct cash allotments to the Bureau, the Appropriation Act for 1939 carried the sum of $155,000, provided for the construction of new hatcheries in Kansas, North Dakota, Minnesota, and Ohio. A suitable site was located at Valley City, N. Dak., and, at the close of the fiscal year, the hatchery was approximately 75 percent completed, although not in readiness for operation. Sites were selected at Hebron, Ohio, Farlington, Kans., and New London, Minn., but various difficulties were encountered in acquiring clear titles to these sites, with resultant delay in starting actual construction. At the close of the year, however, preparations were being made to initiate the construction phase at each of these locations. The funds appropriated for these hatcheries were continued available during the fiscal year 1940.

By means of funds allotted from the Public Works Administration and the Works Progress Administration, improvements were also made during the year to the technological byproducts laboratory building and the chemical laboratories in Seattle, Wash.

ALASKA FISHERIES SERVICE

ADMINISTRATION OF FISHERY LAWS AND REGULATIONS

Careful observations of the runs and escapement of salmon were made in all fishing districts, and regulations were modified as seemed desirable. In general, the salmon runs were satisfactory, and most of the changes in regulations during the season were relaxations to permit additional commercial fishing in specified localities. The Commissioner of Fisheries spent several weeks in Alaska inspecting the fishery and fur-seal activities.

Revised regulations, issued on February 11, to be effective in 1939 contained few changes of major importance. The salmon fishing

season was shortened in parts of southeast and central Alaska, and in some localities the season was extended slightly, in view of the satisfactory runs. In order to promote the use of claims for outlying areas that had previously been but little exploited, the limitation on the pack for the Seward-Katalla district as a whole was increased, while a limitation was placed on the output of certain well-known beds in the district. Some additional restrictions were placed on commercial fishing for herring and crabs.

Two 15-year leases of oyster bottoms in Alaska were executed during the fiscal year 1939 under the authority granted by the act of August 2, 1937, for the protection of oyster culture in Alaska. Liberal leasing terms have been established in order to encourage the development of this industry.

Fourteen vessels of the Bureau, five speedboats, and a number of other small power boats were used in the patrol of the fishing grounds. The personnel identified with fishery-protective work numbered 209, including wardens, stream guards, weir operators, vessel crews, and biologists. Chartered airplane service was used to some extent to supplement the vessel patrol, and also for surveys of the spawning grounds and transportation of officials to isolated districts.

Attention was given to the reclaiming of former spawning areas that had become inaccessible to the salmon by reason of accumulated débris from slides and windfalls. This work was largely incidental to the patrol of the fishing grounds. The destruction of predatory trout that feed upon salmon eggs and fry was continued in the Bristol Bay and Cook Inlet regions through funds supplied by the Territory and by local salmon packers. An appropriation of $25,000 was made by the Territorial Legislature in 1939 to continue the improvement of salmon streams and the payment of bounty on predatory trout during the next 2 years.

Biological studies of the salmon and herring were continued, the work in connection with the former being extended to include a comprehensive investigation of the red-salmon fisheries of Bristol Bay. Further studies concerning the effect of predatory trout in reducing the numbers of young salmon were carried on in the Kodiak region. Weirs for counting the escapement of spawning salmon were operated in 11 representative salmon streams.

PRODUCTS OF THE FISHERIES

Notwithstanding the fact that several plants stood idle because of prolonged labor negotiations in the spring and the consequent delay in preparation for the season's operations, the volume of fishery products in Alaska compared favorably with the average for recent years. An outstanding feature was the unusual abundance of red salmon in the Bristol Bay area, resulting in the largest catch ever recorded for that region.

The total output of Alaska fishery products in 1938 was 446,664,000 pounds, valued at $42,870,000, as compared with 452,545,000 pounds, valued at $51,743,000 in 1937. The estimated value of the 1938 catch to the fishermen was approximately $12,040,000, or about $2,198,000 less than in the preceding year. There were 28,084 persons employed in the various branches of the industry, as against 30,331 in 1937.

Salmon products comprised approximately 78 percent in quantity and 91 percent in value of the total output of the Alaska fisheries in 1938. Ninety-three percent of the salmon products consisted of canned salmon, the pack amounting to 6,807,000 cases, or 326,736,000 pounds, valued at $36,637,000. Red salmon represented 37 percent and pinks 47 percent of the total pack of canned salmon, as against 32 percent and 54 percent, respectively, in 1937. As compared with the pack of the preceding year, the output of canned salmon in 1938 showed an increase of 2 percent in quantity but a decrease of nearly 18 percent in value. Ninety-eight canneries were operated, or 15 less than in 1937, and the number of persons employed in the salmon-canning industry dropped from 24,865 in 1937 to 22,280 in 1938.

Seventeen herring plants were operated, as compared with 20 in the previous year, and the quantity of herring products declined from the peak production of 1937, although continuing at a comparatively high level. Other fisheries in which there was a decreased production included the whale, shrimp, and crab industries. Only one whaling station was operated in Alaska in 1938. Halibut landings of the Alaska fleet showed a slight increase in volume, as did also cod, clam, and a few other minor fishery products.

ALASKA FUR-SEAL SERVICE

GENERAL ACTIVITIES

Sealing and foxing operations at the Pribilof Islands were carried on, as heretofore, by the natives under the supervision of a staff of 13 regular employees and a number of sealing assistants. Approximately 80 Aleutian natives also were employed during the summer in connection with sealing activities, and 23 skilled employees of the Fouke Fur Co. were at the islands for several weeks to assist in curing and packing the sealskins.

The byproducts plant on St. Paul Island was operated for the utilization of fur-seal carcasses. Products for the 1938 season amounted to 30,587 gallons of oil and 357,222 pounds of meal. These products, other than small quantities retained at the islands for fox feed, were shipped to Seattle, where the oil was sold for commercial use and the meal was transferred to the Division of Fish Culture for feeding fish at the hatcheries.

On St. George Island a warehouse and three new cottages for natives were built, and improved roads were extended about a mile. Considerable resurfacing of roads also was done there and on St. Paul Island. Four cabins and a powerhouse, as well as some new equipment, were added to the substation for sea-otter investigations and patrol in the western Aleutians.

Valuable cooperative service was rendered by the Navy Department in assibning the U. S. S. *Vega* to carry the annual shipment of supplies to the Pribilof Islands, and by the Coast Guard in patrolling waters of the North Pacific and Bering Sea for the protection of fur seals and sea otters.

Delivery of 8,755 fur-seal skins, or 15 percent of the take on the Pribilof Islands in 1938, was made to an agent of the Canadian Government at Seattle. The Japanese Government, entitled to a like

number under the provisions of the fur-seal treaty of 1911, continued the practice of sharing in the proceeds of sale, rather than taking actual delivery of the skins.

Two hundred and ten fur-seal skins taken by the Japanese Government on Robben Island in 1938 were allotted to the United States as its share under the treaty provisions and were shipped to the Department's selling agents at St. Louis, Mo., for processing and sale.

A new contract for the processing and sale of Government-owned fur-seal and other skins was entered into by the Acting Secretary of Commerce and the Fouke Fur Co., St. Louis, Mo., under date of June 9, 1939, covering sealskins taken in 1939 and the following season, and thereafter until the contract is terminated by either party.

SEAL HERD

The computed number of animals in the Pribilof Islands fur-seal herd on August 10, 1938, was 1,872,438, an increase of 33,319, or about 2 percent over the corresponding figure for the preceding year. This comparatively small increase is accounted for by the fact that it has been found necessary to apply higher mortality rates for animals in their first year at sea and to make adjustments accordingly in respect to certain age groups.

TAKE OF SEALSKINS

In the calendar year 1938 there were taken on the Pribilof Islands 58,364 fur-seal skins, of which 46,082 were from St. Paul Island and 12,282 from St. George Island. This was an increase of 3,184 over the total take in 1937. Insofar as possible, killings were confined to 3-year-old males. A suitable number of this age class was reserved for breeding stock.

SALE OF SEALSKINS

Two public auction sales of fur-seal skins were held at St. Louis in the fiscal year 1939. At the sale on October 10, 1938, there were sold 9,754 skins dyed black, 14,490 skins dyed safari brown, and 46 miscellaneous skins for a gross total of $509,293.75. On May 22, 1939, 7,800 skins dyed black and 12,720 dyed safari brown brought a gross sum of $344,338.75.

Sealskins sold at private sales under special authorization by the Secretary of Commerce consisted of 324 dyed black, 487 dyed safari brown, 1 partly processed, and 73 raw-salted skins, which brought a gross total of $17,713. In all, 45,695 fur-seal skins were sold for the account of the Government in the fiscal year 1939, for a total gross sum of $871,345.50.

FOXES

The care of blue foxes on the Pribilof Islands is an important seasonal activity, requiring attention only during the winter months when sealing operations are at a minimum. During the 1938–39 season 219 blue and 5 white foxskins were taken on St. Paul Island and 799 blue and 6 white foxskins were taken on St. George Island, a total of 1,029. Suitable reserves for breeding purposes were made

on both islands. Eight hundred and forty-seven blue and 16 white foxskins, taken on the Pribilof Islands in the 1937–38 season, were sold at public auction in the fiscal year 1939. The blue foxskins brought $16,452.50 and the white skins brought $216, a total gross sum of $16,668.50.

FUR-SEAL SKINS TAKEN BY NATIVES

The North Pacific Sealing Convention of July 7, 1911, provides that aborigines dwelling along the Pacific coast may take fur seals under restricted conditions. In 1938 Indians under the jurisdiction of the United States took 184 sealskins and Canadian Indians took 1,367 sealskins, which were duly authenticated by Government officials of the two countries.

FUR-SEAL PATROL

Vessels of the Coast Guard were again assigned by the Secretary of the Treasury to patrol waters of the North Pacific and Bering Sea for the protection of the fur seals and sea otters. One vessel of the Bureau of Fisheries also participated in the fur-seal patrol during the northward migration of the herd.

PROTECTION OF SEA OTTERS, WALRUSES, AND SEA LIONS

New regulations for the protection of walruses and sea lions were issued on June 29, 1939, extending the closed season on these animals until June 30, 1941, while continuing permission for their capture under certain specified conditions. The killing of sea otters is prohibited at all times.

PROPAGATION AND DISTRIBUTION OF FOOD AND GAME FISHES

The preliminary records of production for the hatcheries operated by the Division of Fish Culture show an output of 8,094,000,000 eggs, fry, and larger fish. With the 1938 production amounting to slightly over 8,121,000,000 it is evident that there was little variation in the scope and magnitude of the activities. Forty-six species were handled at the hatcheries and in the rescue fields. Among the individual species an increase was recorded for 16. As usual the greatest increase was shown with the commercial or semicommercial species. The Bureau initiated the propagation of Kentucky bass, which had not previously been handled at its hatcheries. No glut herring, carp, or humped-back salmon were handled at the hatcheries during the fiscal year 1939. The conduct of repair and improvement work rendered some of the fish-cultural facilities inoperative during the season with consequent curtailment of production of fish. The output of brook-trout eggs was unusually low because of the fact that a disease epidemic at the York Pond, N. H., station, the principal point of production for this species, necessitated a complete elimination of all stock on hand and reduced the distribution to negligible proportions. The production of fingerlings and large fish was 84,459,000, which presents a sharp drop in comparison with the previous year when 119,000,000 were handled. This, however, does not indicate any limitation upon the hatcheries' activities but is rather a reflection of the virtual cessation of rescue and salvage work in the Upper Missis-

sippi River Wild Life and Fish Refuge, from which source the fingerlings of warm-water species have heretofore been obtained in large numbers. The number of unfilled applications for game species as submitted by private individuals and conservation organizations was, at the close of the year, as low as at any time within recent years.

PROPAGATION OF COMMERCIAL SPECIES

The three hatcheries in New England propagating commercial species of the inshore waters were operated with increased intensity with the result that there was a noticeable increase in the production of cod, haddock, and flatfish. Pollock were produced in reduced quantities and the output of lobster fry was approximately 50 percent of the previous year's record. However, by virtue of new experimental methods the young lobsters were reared to larger size before releasing, as a means of producing greater survival. Over 5½ billion of the above-mentioned species were distributed as fertilized eggs on the spawning grounds. This is a byproduct recovery, since these eggs would otherwise be completely wasted in the marketing of the fish taken by the commercial fishermen. Propagation of mackerel was again resumed at the Woods Hole, Mass., station with an output of 11,000,000 fry. An outstanding development was the establishment by the Maine Department of Sea and Shore Fisheries of a large modern lobster-rearing unit on the grounds of the Federal hatchery at Boothbay Harbor, Maine. This establishment is operated by the State on a cooperative basis with the Bureau. There is assurance that this project will be of great significance in the future in conserving and building up the supply of lobsters, the mainstay of the inshore fisheries of the State.

Pacific salmon.—There was a worthwhile increase in the production of chinook salmon. This species is handled in two fields, the Columbia River and the Sacramento River, and the distribution was materially increased in both areas. This is especially gratifying in view of the fact that both runs have been threatened by the construction of large dams, and the 1939 figures for hatchery production indicate that there will be a satisfactory stock of salmon upon which to base future propagation activities which will serve to nullify the detrimental influences of dams. Absence of humped-back salmon in the records is merely a result of the so-called "off year" for this species. Sockeye salmon are handled in the Puget Sound area and at Quinault, Wash. At the latter point the production is deliberately curtailed so as to permit the rearing of all of the fry produced to a larger size before distribution. The salmon hatcheries also included the propagation of steelhead trout, a preeminent game fish, within the scope of their work but failed to obtain a production equal to that of the previous year.

Anadromous species, Atlantic coast.—The second year of an intensive program of rehabilitation of the shad has shown an increase in the hatchery production of this species. Over 34 million fry were planted, in comparison with 26 million in 1938. No new propagating stations were operated and the increase is a direct result of larger runs and more intensive hatchery utilization of the potential egg supply. The shad stations on the Potomac River and at Edenton, N. C., also proagated other indigenous species, including the white

perch, yellow perch, and striped bass. These are handled somewhat as a side line since they are propagated during the inactive season for shad. The output of 1,797,000 striped bass fry in North Carolina represents a material increase and is in line with an effort to build up this valuable species.

Commercial species, interior waters.—Inasmuch as the supply of buffalofish and carp appears adequate for economic needs the hatchery production of these forms was curtailed and no carp whatever were distributed. Several of the States in the Great Lakes area are opposed to any promiscuous propagation or distribution of carp and the Bureau has coordinated its work accordingly. As a consequence the present contribution to the commercial fisheries of the interior section was the propagation of whitefish, lake herring, and lake trout carried on at Put-in-Bay, Ohio; Duluth, Minn.; and Cape Vincent, N. Y. Production of pike perch at Put-in-Bay was brought up to 334,000,000, a noticeable increase over 1938. The aggregate production of whitefish at the Bureau's stations amounted to approximately 33,000,000, somewhat lower than the previous year. Lake trout production at a level of slightly over 2,000,000 reflects the difficulty of securing eggs of this species. A new policy was adopted in connection with the propagation of the lake trout, however, by the reopening of the Bureau's hatchery at Charlevoix, Mich., for the purpose of rearing the fish to the fingerling size before release. Several hundred thousand lake-trout fry were supplied by the Michigan Conservation Department and were being fed at the Charlevoix hatchery at the close of the year. The activities at the Put-in-Bay, Ohio, station were conducted jointly with the State of Ohio, as has been the case for several years. It is felt that the State is in a position to take full responsibility for this work and at the close of the year negotiations were under way whereby the hatchery property might be turned over to the State.

Game species.—Again the collection of black-spotted trout eggs at Yellowstone Park was materially increased, the collection of eggs approaching 40,000,000. There was a moderate drop in the production of the other species of game trout, and a noticeable increase in the production of largemouth and smallmouth bass, the distribution amounting to over 14,000,000. Of this total, approximately 9,000,000 represented the fingerling and larger sizes which are so eagerly sought for restocking the tremendous area in which these two species thrive. The yield of the lesser warm-water species, including the sunfish, crappie, rock bass, warmouth bass, catfish, etc., was greatly below the levels maintained previously. However, as indicated elsewhere, this is of little significance as far as stocking is concerned because of the fact that the millions released in previous years were largely replanted directly in the Mississippi River in the area where they were salvaged. There was a continuation of the program for acquiring more distribution trucks, and the handling of fish applications was systemized and organized so as to coordinate the planting with the corresponding activities of the States. More and more of the game fish from Federal hatcheries are being utilized in stocking Federal lands, particularly in national forests, reclamation reserves, Indian reservations, and tracts which have been acquired in the land-utilization program.

The Bureau again made an allotment of rainbow trout eggs to Puerto Rico in continuation of the program for developing trout fishing in that Territory.

RESCUE OPERATIONS

The virtual completion of the 9-foot channel in the upper Mississippi River brought to a practical close the practice of salvaging fish in the overflowed areas and sloughs, which development has been predicted by the Bureau. There were handled in this activity only 2,800 fish of all species in comparison with the 40 to 50 million which were seined and returned to the river in the past. The Bureau, however, has proceeded with the construction of propagating ponds in the Refuge, particularly at Genoa, Wis., and Guttenberg, Iowa. The yield of game fish, especially bass, from these ponds has been most surprising and there is ample evidence of a continuing supply of bass and sunfish if the program of construction can be continued.

FISHERY INDUSTRIES

ECONOMIC AND MARKETING INVESTIGATIONS

Surplus fish situation.—The holdings of frozen, cured, and canned fishery products in the United States in the spring of 1939 amounted to about 172,000,000 pounds, according to a study of the surplus fish situation. This represents about 5,600,000 pounds more than normal holdings.

Survey of retail marketing of fish and shellfish.—The field work of a survey of retail marketing of fish in about 50 representative cities east of the Mississippi River was completed late in the fiscal year 1939. The results of the survey will be tabulated and analyzed to determine the factors which lead to the most favorable response from the public and to establish criteria which may guide retailers toward those practices which are most successful or promising.

Commercial fisheries of the world.—On the basis of the most recent available data, the world's annual commercial catch of fishery commodities amounts to about 33,600,000,000 pounds, valued at approximately $740,000,000. The United States, including Alaska, ranks first in the value of annual yield and is exceeded only by Japan in volume.

Cod fisheries off the east coast of North America.—In 1935, which is the most recent year for which complete statistics are available, the catch of cod off the east coast of North America by Canadian United States, French, and Portuguese fishermen, amounted to 1,109,000,000 pounds, as compared with an average annual catch of 1,108,000,000 pounds for the 10-year period from 1926 to 1935, inclusive, and 1,169,000,000 pounds for the preceding 10-year period. The most important country in the volume of its catch of cod in this area is Newfoundland, which took an annual average of 495,000,000 pounds during the period from 1931 to 1935. Following in order of the importance of their annual catches were Canada, France, the United States, and Portugal.

Cooperative marketing.—During 1938 work was continued on the collection of data relating to fishermen's cooperatives and other fishermen's organizations in this country and abroad. Appeals for aid

in organization of cooperatives have been received from many sections of the country and such assistance has been rendered as has been possible with the limited staff and funds available for this work. Arrangements have been completed to enlist the aid of statistical and marketing agents of the Bureau, who visit virtually all the fishing areas of the United States each year, to assist in keeping the Bureau's data on fishermen's organizations current.

STATISTICAL INVESTIGATIONS

FISHERIES OF THE UNITED STATES, CALENDAR YEAR 1937

New England States.—The commercial fisheries of Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut in 1937 gave employment to 19,624 fishermen who took 670,864,000 pounds of fishery products, valued at $19,937,000. This is an increase of 2 percent in volume and 11 percent in value as compared with 1935 when the most recent previous survey of the total catch was made. Landings by United States fishing vessels at Boston and Gloucester, Mass., and Portland, Maine, in 1937, amounted to 387,960,000 pounds, valued at $9,790,000—a decrease of 6 percent in volume and 12 percent in value as compared with 1936.

Middle Atlantic States.—During 1937 the commercial fisheries of New York, New Jersey, Pennsylvania, and Delaware gave employment to 7,720 fishermen. Their catch amounted to 264,652,000 pounds, valued at $7,896,000—a decrease of 5 percent in volume but an increase of 23 percent in value as compared with the catch in 1935 when the preceding complete survey of the catch was made. A survey of the Hudson River shad fishery for 1937 showed that 613 fishermen took 2,732,000 pounds of shad, valued at $213,000—an increase of 11 percent in volume and 25 percent in value as compared with the catch in the previous year.

Chesapeake Bay States.—In 1937 the commercial fisheries of Maryland and Virginia employed 16,529 fishermen. Their catch amounted to 292,244,000 pounds, valued at $6,361,000—a decrease of 7 percent in volume and 2 percent in value as compared with the previous year.

South Atlantic and Gulf States.—The commercial fisheries of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas gave employment to 30,244 fishermen in 1937. Their catch amounted to 546,751,000 pounds, valued at $14,226,000—a decrease of 2 percent in volume but an increase of 5 percent in value as compared with the previous year.

Pacific Coast States.—During 1937 the commercial fisheries of Washington, Oregon, and California gave employment to 21,555 fishermen, whose catch amounted to 1,576,877,000 pounds, valued at $28,776,000. This is a decrease of 18 percent in the volume but an increase of 16 percent in the value of the catch as compared with the previous year. The total catch of halibut by United States and Canadian vessels in 1937 amounted to 48,659,000 pounds, valued at $3,828,000—an increase of 1 percent in volume and 6 percent in value as compared with the catch in the preceding year.

Lake States.—In 1937 the commercial fisheries of the United States and Canada, in the Great Lakes and international lakes of northern Minnesota (Lakes Ontario, Erie, Huron, Michigan, and Superior,

Namakan and Rainy Lakes, and Lake of the Woods), yielded 116,064,000 pounds of fishery products. Of this amount, United States fishermen took 83,958,000 pounds, valued at $6,033,000—a decrease of 11 percent in volume and 6 percent in value as compared with the catch in the previous year. The Lakes fisheries of the United States gave employment to 6,418 fishermen in 1937.

Mississippi River and tributaries.—Complete data on the fisheries of the Mississippi River and its tributaries were not obtained for 1937. The catch of Lakes Pepin and Keokuk and the Mississippi River between the two lakes in 1937 amounted to 5,585,000 pounds, valued at $226,000—a decrease of 32 percent in volume and 40 percent in value as compared with the catch in these waters during 1936.

MANUFACTURED PRODUCTS OF THE UNITED STATES AND ALASKA, CALENDAR YEAR 1937

Fresh and frozen packaged fishery products.—In 1937 the domestic production of fresh and frozen packaged fishery products amounted to 201,803,000 pounds, valued at $27,678,000. Important commodities in this group were fresh-shucked oysters, 6,644,000 gallons, valued at $9,081,000; packaged haddock, 30,187,000 pounds, valued at $4,162,000; and fresh-cooked crab meat, 8,300,000 pounds, valued at $2,822,000.

Frozen products.—The production of frozen fishery products in 1937 amounted to 168,224,000 pounds, estimated to be valued at $14,600,000. The volume of the production was 6 percent less than in 1936. The principal items frozen were groundfish, whiting, salmon, halibut, and rosefish.

Cured products.—The production of cured fishery products, based on surveys for 1937 in all sections except the Mississippi River, and for 1931 in that area, amounted to 104,339,000 pounds, valued at $15,636,000. Important products in this group were smoked and kippered salmon, 12,173,000 pounds, valued at $3,515,000; salted cod, 19,857,000 pounds, valued at $2,379,000; and mild-cured salmon, 9,615,000 pounds, valued at $1,863,000.

Canned fishery products.—In 1937 the production of canned fishery products amounted to 742,197,000 pounds, valued at $105,175,000—a decrease of 7 percent in volume but an increase of 11 percent in value, as compared with 1936. Canned salmon was the most important item, accounting for 362,642,000 pounds, valued at $52,924,000. Other leading canned fishery products were tuna and tunalike fishes, sardines, shrimp, mackerel, clam products, and oysters.

Byproducts.—The production of fishery byproducts in 1937 was valued at $36,804,000—an increase of 17 percent as compared with the previous year. The principal products in this group were marine-animal oils and meals and aquatic shell products.

FISHERY MARKET NEWS SERVICE

The past year has been one of intensive activity in the development of the Fishery Market News Service and in the opening of new offices. Field offices for the daily collection and dissemination of fishery market news are now operating in New York, N. Y.; Boston, Mass.; Chicago, Ill.; Seattle, Wash.; and Jacksonville, Fla. In addition to these offices for the preparation and dissemination of daily reports,

the service also operates numerous news-reporting activities in important fish-producing areas along our coasts. These reporting activities make possible the inclusion of a much wider coverage of news in the daily reports of our field offices than would otherwise be possible. Periodic market news reports also are prepared and disseminated from the Washington office. These include summarized data made available through the daily and monthly reports of the field offices as well as articles relating to the commercial fisheries and other related information.

TECHNOLOGICAL INVESTIGATIONS

Preservation of fishery products for food.—During 1938 projects in this field included studies of rancidity in fish, of lactic acid as a possible index of decomposition in frozen fish, of identification of canned salmon, of changes in the composition of pink salmon, of the composition of commercial species of fish taken on the Pacific coast, and the canning of aquatic products.

Of particular interest has been the work on lactic acid as a possible index of decomposition in frozen fish. It is known that lactic acid rises to a maximum content in fish muscle during the rigor of death. It has also been shown that the alkaline reaction of fish muscle and the accompanying onset of spoilage of the fish follows after the loss of muscular rigor. Since spoilage occurs after the lactic acid content of the fish muscle reaches a maximum, the determination of lactic acid in fish flesh before and during a period of cold storage is of value in obtaining direct knowledge of the processes of decomposition of fish.

Information has been obtained regarding the changes in the chemical composition of pink salmon accompanying the pronounced physical change during their spawning migration and while in the commercial fishery. Additional data have been collected in connection with the development of a means for identifying the various species of salmon after canning. A survey has been undertaken to determine the chemical composition of the principal food fish of the Pacific coast, and the wastage occurring during their preparation for market. Studies were continued to determine the effectiveness of certain natural antioxidants in preventing rancidity in preserved fishery products and an attempt is being made to develop a simple and accurate method for measuring oxidative deterioration in fatty fish.

Bacteriological studies.—During the past year important bacteriological problems were studies of ultraviolet rays in killing bacteria, studies in the handling of fresh oysters, and studies of methods of preparing crab meat.

The studies in the handling of fresh oysters revealed that there is a definite relation between the pH in oysters and the bacterial count. The experiments showed that the bacterial flora changes with the acidity of the oysters and the bacterial count rises as a result of the increased acidity of the oysters. It was further discovered that excessive washing of oysters with fresh water caused a loss of mineral content.

At the request of several members of the crab-meat industry, the Bureau assigned a chemist and a bacteriologist to investigate possible measures designed to improve the quality of their product. This investigation included a survey of the crab-meat packing plants with

a view to making recommendations as to improved methods of handling and packing for shipment which would assure the public a higher quality product. Tentative recommendations were made to the crab-meat packers pending the issuance of a completed report.

Pharmacological studies.—As indicated in previous years, the role of minerals in nutrition has become increasingly important. Fishery products are considered to be an excellent source of minerals in quantity and variety, and a better understanding of the physiological effects of these minerals on the animal organism is necessary. During 1938 the Bureau's technologists completed a study of the chemical and pharmacological aspects of fluorine in fishery products. No toxic symptoms were observed when the fluorine in the diet came from salmon or mackerel.

Nutritive value of fishery products.—During 1938 investigations in this field included a study of the chemical composition and nutritive value of fish proteins, the vitamin content of fishery products, a study of sodium alginate (produced from sea kelp) as a stabilizer in products of the dairy industry, and a cooperative study of kelp meal in animal feeding at the dairy department of the University of Maryland and of the Maryland State Agricultural Experiment Station, College Park, Md.

The studies of the mineral constituents of fishery products showed that fish fillets are about equal to the muscle cuts of beef in mineral content, except that the fish greatly exceeds the meat in iodine content; that canned salmon contains about 15 times as much calcium, almost twice as much phosphorus, 20 times as much iodine, and approximately equal quantities of other minerals as beef round; and that oysters, shrimp, and crab meat contain approximately half as much calcium, more than 5 times as much magnesium, and more phosphorus than an equal quantity of milk. In addition, these shellfish are a particularly good source of iron, copper, and iodine.

The results of the studies on the chemical composition and nutritive value of fish proteins showed that, by using an arbitrary factor of 100, the proteins of the following fish and shellfish fell into the following groups according to relative growth-promoting value, as compared to beef at a factor of 63: Oysters, 100; pilchard, red snapper, shrimp, and Boston mackerel, 90; and shad, cod, croaker, and silver salmon, 80.

The results of the studies on sodium alginate showed that this product is an excellent mechanical stabilizer for use in food products, due to its chemical and physical properties and high viscosity value.

Preservation of fishery byproducts.—During the year data have been obtained regarding specific problems of salmon cannery waste utilization. These include investigation of the suitability of small-unit operations for canneries whose outputs are too small to warrant installation of standard fish-meal equipment, the preparation of edible salmon oils, the preparation of dehydrated protein and vitamin concentrates, and in the case of large canneries having short operating seasons, the chemical preservation of waste for subsequent reduction and the conversion of waste into new types of products as a result of chemical treatment. A survey was undertaken to determine the potential vitamin value of the livers and viscera of the principal food fish taken commercially on the Pacific coast. In cooperation with the Division of Fish Culture and the University of Washington

School of Fisheries, information was obtained which helps to clarify the steps in preparation responsible for improving the nutritional properties of fish meal for fish feeding and which suggest less costly processes of manufacture. Also, studies were made which indicate the possibility of materially reducing the danger of spontaneous heating of fish meal, a difficulty which now causes the industry great inconvenience and considerable financial loss.

BIOLOGICAL FISHERY INVESTIGATIONS

INVESTIGATIONS OF COMMERCIAL FISHES

North Atlantic fishery investigations.—In the offshore fisheries of New England, analysis of extensive data collected during the course of the haddock investigation has thrown considerable light on the changes in the abundance of this species and has suggested a plan for the stabilization of yield. Years of poor survival are either years in which large haddock are especially abundant, offering serious competition for food, or years when the stock of adults has been so reduced as to furnish insufficient spawners. The most favorable level was approximately that which prevailed in 1922 to 1924, 1929, and 1936. The course of the natural cycles of abundance may be seriously interfered with if a period of intensive fishing happens to coincide with a period of poor survival of the young. The recent marked decline in the abundance of haddock, which has been evident both on Georges and the Nova Scotian Banks has been shown to be the result of such a combination of circumstances. It is indicated, therefore, that by holding the population at the optimum level by regulation of the fishing intensity, it would be possible to sustain the yield at a productive level.

Data collected during the year on the age composition of the catch revealed an increasing dependence on the young or "scrod" haddock, a trend which is regarded as prejudicial to the interests of the fishery, inasmuch as these fish are growing rapidly and would be of considerably greater value if allowed at least 1 more year's growth.

The catch records and biological data collected during the 1937 mackerel season, a year of extremely low production, were subjected to analysis during the year. The composition of the mackerel population differed markedly from previous years in that no year class or classes dominated the fishery. With the exception of the 1932 class, year classes following 1929 were present in better than 5 percent strength each. Inasmuch as a study of lightship temperature records revealed that water temperatures in the western part of the Gulf of Maine ran higher than the average for the previous 10 years, it is suspected that hydrographic conditions affected the distribution of mackerel and were an important factor in the low catch.

The catch for the 1938 season was almost double that of 1937, but the early season landings for 1939 sank to a lower level than those for the corresponding period of 1937. Biological data show that the mackerel spawned in 1937, a group that was expected to contribute much to the fishery, as 2-year-old fish were virtually unrepresented in 1939. Because pound-net fishermen inshore were reported to be making good catches, an investigation of the relation between the catch by seiners offshore and that of the pound nets was begun early in the 1939 sea-

son to determine to what extent changes in the offshore catch may represent merely changes in the distribution of mackerel.

During the fiscal year 1938 a study was undertaken to determine whether a decline in abundance of flounders is in progress in the North Atlantic area. In order to interpret fluctuations in abundance, it was necessary to develop techniques for determining age and growth, the existence of separate races within the population, and the extent of migrations.

Owing to the increased utilization of redfish, flounders, and other species of groundfish in addition to haddock, an investigation of the abundance of such fishes was begun during 1938. The central problem is to assess total catch, fishing effort, and abundance in order to determine for each species whether it has already reached the point where an increase in yield will give a larger production only with detriment to future supplies.

As a result of cooperation between the Bureau of Fisheries and the State of Maine, an investigation to test new methods of rearing lobsters, to determine the relative effectiveness of artificial and natural propagation, and to ascertain the condition of the lobster fishery on the coast of Maine has been added to other scientific fishery investigations being conducted in the New England area. The State has constructed a lobster-rearing plant adjacent to the Bureau hatchery at Boothbay Harbor, with facilities for carrying on experimental work, and has assigned funds for the employment of a biologist. Experiments with larval lobsters and tagging of adults were begun during the spring of 1939.

Middle and South Atlantic fishery investigations.—At the request of the New York State Conservation Department, the Bureau participated in a biological survey of the marine fisheries of Long Island, acting principally in an advisory capacity. The survey was undertaken to provide a basis for improving or maintaining good fishing wherever the supply is controllable and to determine by a census of fishing activities the recreational and commercial value of the marine district of Long Island. Definite recommendations for the conservation of several species and for additional study have been included in a report to be published by the State.

Evidence continued to accumulate which indicated an inadequate spawning escapement as the principal cause of the decline in abundance of shad along the Atlantic coast. Much of the field work of this investigation has been directed toward comparison of the spawning escapement in the Hudson, where complete recovery of abundance has occurred, with the escapement in other rivers which are still severely depleted. The principal methods of study are tagging experiments, designed to estimate fishing intensity from the percentage of tags recovered, and studies of scales intended to estimate the percentage escapement from the percentage of scales bearing spawning marks.

Prior to recommending measures to insure an adequate number of spawners in the various coastal rivers, it was necessary to determine whether shad return to spawn in their native rivers or whether, as many fishermen believe, there are extensive migrations. A direct attack on this problem has been made by tagging. Results of tagging experiments in North Carolina, the Chesapeake Bay, and the

Hudson indicate that the great majority of shad return to the same river year after year. Additional data on this point are being gathered by extensive analysis of the racial characteristics of shad from the different rivers.

Because of the importance of reproduction in shad conservation a careful ecological study of the early life history is being made in southern rivers. In 1938 intensive work was done in the Edisto and in 1939 these studies were extended to other rivers.

Shrimp investigations.—Studies of the shrimp fishery consisted of several cruises to assess available supplies in the offshore waters of the Gulf of Mexico, a continuation of tagging experiments to determine the seasonal migrations of shrimp along both the Atlantic and Gulf coasts, and ecological studies of the relationship between environmental changes and the distribution of shrimp along the Texas coast.

As a result of a cruise of the *Pelican* along the Louisiana and Texas coasts in January and February, the presence of shrimp off the Louisiana coast in concentrations sufficient to warrant commercial exploitation was confirmed. No large concentrations of commercial shrimp were found off the Texas coast. In a later cruise a similar lack of commercial shrimp was observed off the coasts of Alabama and Florida between Mobile Bay and Apalachee Bay.

Tagging of shrimp on the Atlantic coast from Cape Canaveral to St. Augustine, where the bulk of the South Atlantic coastal shrimp congregate for the winter, gave evidence of a return movement at least as far as 250 miles northward. Other tagging experiments indicated that the small shrimp do not engage in coastwise migrations as extensively as do the larger sizes.

In cooperation with the Texas Game, Fish, and Oyster Commission, a program of hydrographic surveys and experimental trawling was instituted in Aransas Bay to determine the extent to which hydrographic factors may control the distribution of shrimp and day-to-day fluctuations in the catch.

North Pacific and Alaska fishery investigations.—Commercial fishery investigations in northern Pacific waters form the basis of recommendations for the management and conservation of the salmon runs in the rivers of the Northwestern Coastal States. They are also concerned with maintaining at a productive level the salmon and herring fisheries of Alaska, over which the Federal Government has regulatory power.

The activities of the Columbia River staff have centered about the problem created by the erection of Grand Coulee Dam, blocking that portion of the Columbia River salmon run that normally spawns in tributaries of the upper Columbia. Salvage operations were begun in 1939. The runs are being trapped at Rock Island Dam, 150 miles downstream, and transferred in specially constructed trucks to tributaries between Rock Island and Grand Coulee Dams. It is hoped that the fish will spawn in these tributaries, and that their progeny will later return to them. If the plan yields the anticipated results, the entire run of upper Columbia fish will be transferred to tributaries below Grand Coulee within a period of 5 years, or the life cycle of a salmon.

At the beginning of the fiscal year 1939 Congress made funds available to the Bureau of Fisheries for a large-scale study of the factors that control the salmon populations of Bristol Bay in order that a sound and comprehensive system of management might be applied. With the cooperation of the Coast Guard, extensive hydrographic observations were conducted in the summers of 1938 and 1939. Biological observations were made also to discover the schooling habits of the fish far offshore, the abundance and distribution of food animals, and the migratory habits of the salmon in approaching the coast from these offshore feeding grounds. Correlated with these oceanographic studies, investigations of the life cycle of the salmon in the five major watersheds of this area are under way. These include detailed population studies of the spawning runs, surveys of spawning grounds, and measurement of the mortality of the young in fresh water. This investigation is planned to cover a 5-year period, or the normal life cycle of the red salmon.

Studies of the returns to be expected from any given escapements of spawning salmon were continued in the Karluk watershed. Further evidence was secured that variations in the ratio of returns to escapement are mainly due to conditions existing in the fresh-water environment. To determine the role of the predatory Dolly Varden trout in reducing the number of young red salmon, the migratory habits and biological characteristics of the populations of trout have been investigated through the tagging of large numbers of these fish.

In areas where the migration routes of salmon pass through commercial fishing areas to a number of different streams, the 50-percent escapement required by law cannot be assured unless the exact routes of the salmon and their distribution on the spawning grounds are determined. Tagging experiments were conducted during the 1938 and 1939 seasons to trace the migration routes of pink salmon passing through Lower Chatham Strait. The two experiments will provide information covering the routes of migration of both the odd- and even-year pink salmon runs.

The usual population studies to determine the size of the pink-salmon runs and the proportion of males and females were conducted at Little Port Walter. The construction of a permanent dam and counting weir, which was in operation during the 1939 season, now permits an accurate count of seaward-migrating young as well as upstream migrants, so that the returns from a known number of spawners may be determined with greater accuracy than heretofore. Changes in the time of appearance of the pink salmon runs are being closely analyzed so that any necessary curtailment of the fishery may be effected in time to allow an adequate escapement to the spawning grounds.

As an aid to rebuilding the runs of coho salmon in Puget Sound, studies have been carried on over a period of years to determine the age at which hatchery-reared fry may be released most advantageously. A series of marking experiments for this purpose was concluded in 1938. Biological studies of the size and age composition of the population were made by taking samples of the commercial catch and of the fish on the spawning grounds.

Studies of the age composition of the herring population of southeastern Alaska were responsible for demonstrating that this stock

has declined to a dangerously low level and that curtailment of fishing is necessary. The decline has been caused by the virtual failure of three successive broods, those of 1932, 1933, and 1934, combined with excessive fishing. Closure of the Cape Ommaney area was recommended until the population shows definite signs of recovery. The fishery of the Prince William Sound and Kodiak areas continued at a high level of abundance, but since considerable expansion is contemplated, a close watch must be maintained to avoid overexploitation.

Collection, tabulation, and analysis of the daily catch records from the various types of fishing gear operated by the salmon fishing industry in Alaska have been continued. Indexes of abundance derived from these data are an important basis of recommendations for changes in the fishing regulations.

Pilchard investigations.—Although biologists of the Pacific Coast States have already collected a considerable body of information bearing on the migrations, spawning, and age and growth of the pilchard, the basic problem remaining for solution is the determination of the optimum level of catch below which the stock would go to waste through underutilization, above which it would become reduced to commercial unimportance through overexploitation. To provide a basis for determining this level, the staff conducted studies dealing with the determination of abundance, age, and reproductive success, and with the importance of intermigration.

The use of aerial observers in gaging abundance was tested but rejected as unsatisfactory. Changes in relative abundance are therefore being determined by statistical analysis of the commercial catch records over a period of years.

To discover how much the stock is reduced by fishing it is necessary to determine the ages of the fish making up the population each year, thus learning the relative abundance of the individual broods of previous years and how fast they are removed by fishing and by natural mortality. Age determination is being attempted by interpreting marks in scales and otoliths, by observing the growth of young pilchards, and by identifying modes in frequency distributions of the adult population.

During the spring of 1939 several cruises were made in the spawning and nursery grounds, quantitative samples of the young pilchards being taken. These cruises were made possible by the cooperation of the Scripps Institution of Oceanography, which furnished the vessel *E. W. Scripps.* When the surveys are completed, it is hoped that light may be thrown on the distribution and abundance of eggs and young, as well as on the effect of oceanic conditions on the success of spawning.

To determine whether the pilchard stock in northern waters is self-perpetuating or is maintained by migrations from other areas, techniques are being developed for appraising the contributions from various spawning areas through study of the sculpturing on the scales. If the method proves valid, it will aid in determining how much fishing in specific areas affects the stock in other areas.

Great Lakes fishery investigations.—A state of critical depletion continues to exist among the more valuable commercial species of the Great Lakes. The extent of this depletion is apparent from

comparisons of present-day production of certain species with yields of earlier years. In Lake Michigan, for example, production of wall-eyed pike, lake herring, lake trout, whitefish, and yellow perch varies from 43 to 62 percent of normal. Production of Lake Superior whitefish is only 10 percent of normal. In Lake Huron production of perch and chubs is 44 and 36 percent, respectively, of normal. In Lake Erie production of nearly all important commercial species is on the decline, and total production of Lake Ontario is only 10 percent of normal.

Members of the Great Lakes staff cooperated actively with State and Federal officials and with sport and commercial fishermen, participating in an advisory capacity in 19 meetings and conferences in which Great Lakes fisheries problems were under consideration and assisting State conservation officials in the drafting of fisheries regulations.

At the request of the Office of Indian Affairs of the Department of the Interior, a survey was made of the fisheries of Upper and Lower Red Lakes in Minnesota to settle various controversies concerning the regulation of the commercial gill-net fishery. Recommendations for the management of the fishery are being submitted.

The report of the International Fact-Finding Commission on Lake Champlain was largely completed. The report will contain a discussion of the fisheries controversies, a tabulation and analysis of all available information concerning commercial fishing and angling, descriptions of the natural history of the various species, a critical historical review of the artificial propagation of wall-eyed pike and yellow perch, and recommendations for the regulation of the commercial and sport fisheries of the lake.

Age and growth studies of the whitefish of Lake Huron and Lake Champlain were completed for publication, and life-history studies of the yellow perch were continued.

AQUICULTURAL INVESTIGATIONS

The work of the aquicultural investigations continued along three principal lines: The development of means to obtain the maximum production of food and game fishes consistent with environmental conditions, the improvement of methods of artificially propagating and rearing fish, and the control of fish parasites and diseases.

Investigations were conducted in trout waters to obtain definite information on the annual drain to which the trout population is subjected by anglers and the value of artificial stocking in maintaining a stable fish population. Such studies were conducted through the operation of test waters in Vermont; experimental stocking of streams in the Pisgah National Forest where fishing is closely supervised and an accurate check on returns may be obtained; and the operation of the Convict Creek experimental stream in California. These studies have demonstrated that in some situations natural propagation is superior to artificial in maintaining a stock of trout under adverse conditions and have emphasized the necessity of regulating planting operations in accordance with the amount of natural food present in the streams.

Feeding experiments with fingerling, yearling, and adult trout were carried out at the Leetown, W. Va., and Pittsford, Vt., stations to determine the effect on growth, mortality, and egg production of dry meals fed at different levels and in different combinations. One of the most striking results was the marked increase in growth following the addition of cod liver oil to a diet composed of sheep liver and whitefish meal. Experiments with brood fish showed considerable variation in the hatchability of eggs from fish on different diets.

During the year a regional biologist was appointed to resume fish management work in the Intermountain Region. In this area fishing intensity is increasing rapidly and many of the streams are unable to maintain a sufficient fish population to meet demands. In addition to overfishing, adverse changes in the streams and lakes are important factors in the general decline. Among such changes might be cited silting resulting from overgrazing, hydroelectric and irrigation projects that interfere with normal migrations, and fluctuations of water level in artificial lakes. Management plans have been worked out for several waters showing possibilities of early improvement of fishery resources.

The staff of the California trout investigations has been engaged in determining the number of salmon and the extent of spawning streams that will be blocked by the completion of the Shasta Dam on the Sacramento River. The estimates of the 1938 fall run combined with the counts of the 1939 spring run fish indicate that approximately 25,000 salmon a year will ultimately have to be handled in the salvage operations. Pending the completion of engineering surveys to determine the feasibility of certain alternative features of the plan, a tentative program has been drafted which calls for a combination of artificial propagation and provision of areas for natural spawning below the dam.

Field work in bass streams was designed to measure the extent and efficiency of natural propagation and the effect of intensive fishing on the bass population. An important result of these studies was the finding that even in heavily fished waters there is little danger of serious depletion of bass if adequate spawning facilities are available. However, intensive fishing frequently leaves excessive numbers of small bass, with consequent reduction in the abundance of forage fishes. It is apparent that the remedy is to build up the food supply and that stocking with young will only serve to intensify the unbalanced condition. Programs for the effective management of bass in ponds and lakes are being developed in Florida.

Facilities for the experimental study of fish diseases were greatly increased during the year with the enlargement of the field laboratory at the Quilcene, Wash., hatchery, and the provision of a second experimental laboratory through the cooperation of the University of Washington. Studies of various disinfectants used in the prevention and treatment of disease were continued to determine the maximum nontoxic concentrations that the fish could withstand. Studies of common bass parasites, believed to be an important factor in the mortality of the young, were carried on at Leetown, W. Va. The Disease Service continued to aid Federal, State, and private fish-culturists in the diagnosis of hatchery disease.

POLLUTION INVESTIGATIONS

Field and laboratory studies have been continued over a wide area of the country for the purpose of analyzing stream and hatchery waters from the standpoint of their suitability for various types of fishes and of determining the harmful actions of specific pollutants. Methods of determining the physiological condition of the fish themselves have been markedly improved.

Many of the findings of the past year are of considerable interest and importance. For example, it has been found that arsenicals and other materials commonly used as mosquito larvacides impair the growth and nutrition of fishes even though used in very small quantities, and may also build up serious hazards of lethal poisoning. It has also been demonstrated that small quantities of many substances, normally present or introduced into streams and lakes, may have a cumulative effect over a period of time that is even more detrimental to fish life than many more obvious pollutants. Certain minerals found in small quantities in various western streams and several inorganic salts that are common in southern and western waters exert this type of cumulative action.

Problems arising from the concentration of minerals and other compounds hazardous to fish and other aquatic life in impounded waters have been investigated at Elephant Butte Reservoir, N. Mex., and Lake Mead, Nev.

Acute pollution problems were investigated during the year in Florida, South Carolina, North Carolina, Minnesota, Idaho, Montana, Oregon, and Mississippi. Specific types of industrial pollution studied include that produced by paper mills, phosphate mines, and copper, lead, zinc, and placer gold mining operations.

CONSTRUCTION OF FISH-PROTECTIVE WORKS

A section on hydraulics has now been established under the supervision of the Division of Scientific Inquiry, with an experienced engineer for the design of fish-protection facilities. During the year the engineer assisted in designing and supervising the installation of fish screens being constructed with the aid of P. W. A. and W. P. A. funds on certain Federal power and irrigation projects in the Northwest. Important consulting services on screens and ladders were also afforded to other agencies.

SHELLFISH INVESTIGATIONS

Scientific investigations have been directed toward increasing the cultivation of oysters, improving the quality of oyster meat, and standardizing the raw and canned product.

In the Long Island Sound area, where the collection of a good crop of seed oysters is of paramount importance to the industry, regular bulletins were issued during both the 1938 and 1939 seasons advising oystermen when spawning and setting might be expected. To aid in protecting valuable beds from starfish, surveys of the distribution of this oyster enemy were made and the results communicated to oystermen, permitting more efficient eradication.

On the south Atlantic coast, although generally favorable conditions for growth are found, some beds are badly overcrowded. Experiments are being conducted to develop a method of protecting seed oysters from the attachment of larval oysters, barnacles, etc., so that they may be grown to marketable size as single individuals of good quality.

Experimental oyster beds have also been established in South Carolina to develop methods of cultivation suitable for small oyster farms, from 2 to 10 acres in extent, to be leased and operated by the tidewater residents. The program differs from previous experiments in presupposing that capital requirements will be at a minimum and that materials, equipment, and supplies will be obtained or produced by the labor of the oyster farmer himself.

At the Pensacola, Fla., laboratory an experimental oyster farm is being established to determine rates of growth and fattening, productivity annually per unit of bottom, and costs of production. The results will be compared with those of similar projects conducted on the Atlantic coast. A program of oyster planting and of rehabilitation of exhausted natural beds is also being conducted from this laboratory.

Investigations carried out at the Yorktown laboratory demonstrated that pollution of the river by pulp-mill wastes has brought the decline of the oyster fisheries. During the past year intensive chemical studies were carried on for the purpose of determining the particular chemical or chemicals in the pulp-mill effluents which are responsible for the altered physiology of oysters. An attempt will then be made to find a means of eliminating the harmful substances.

Studies of the physiology of the oyster carried out at Woods Hole, Mass., included investigations of the phenomenon of sex reversal in adult oysters, experiments on the time of survival of eggs and sperm, and a study of respiration in relation to the carbohydrate metabolism of the oyster and the accumulation of elements which are important food constituents of oyster meat.

LAW ENFORCEMENT DIVISION

The act of July 2, 1931, the Federal Black Bass Law regulating interstate commerce in black bass, is administered by this Division; also certain parts of the Whaling Treaty Act of May 1, 1936, giving effect to the various international treaties for the protection of whales. The Division also maintains an angler's service, and issues permits to take bait fish in the District of Columbia.

The Federal black bass law.—The personnel and methods of enforcement remain the same as last year. Owing to insufficient personnel, no particular effort has been made to carry on the work west of the Rocky Mountains, where salmon and trout predominate. Reports of illegal interstate shipments of black bass have been investigated, producing evidence of violations of both State and Federal laws. A number of these cases have been turned over to the States for prosecution in State courts, as such action generally produces quick and effective results. Two cases of illegal interstate shipments of black bass by trucks were successfully prosecuted during the year, a fine of $100 and 1 day in the custody of the U. S. Marshal being

assessed in each case. The defendant in one of these cases remained in jail approximately 3 months previous to trial, being unable to furnish the required bond.

Improvements in State laws protecting black bass have been continued in accordance with the Bureau's recommendations for adequate protection. Thirty-nine States now prohibit the sale of black bass at all times, regardless of where taken, and all but four States provide a closed season on these game fish during at least a part of the spawning period. The States have cooperated 100 percent in carrying on this branch of the work. A summary of the game-fish laws for 1937–38, with special reference to black bass, was prepared and published, also several leaflets on subjects pertaining to angling.

Whaling.—The total number of licenses issued for taking whales was 15—covering 3 shore stations and 12 catcher or killer boats. The total revenue received for these licenses was $4,750 which was covered into the United States Treasury.

The Division prepared, in accordance with the terms of the Whaling Convention of September 24, 1931, two statistical reports covering the number of whales captured, species, size, etc., and has made biological studies of the samples of stomach contents taken from whales captured by United States vessels. It has completed two biological reports which, together with the two statistical reports, were forwarded to the International Bureau of Whaling Statistics, Sandefjord, Norway, as required under the convention.

Angling.—Requests for information on how, when, and where to fish with rod and line have increased during the fiscal year. Thirty-nine permits, required by act of Congress, to take certain small bait fish in the District of Columbia were issued.

VESSELS

Fifteen vessels of the Alaska service cruised approximately 107,000 nautical miles in the fiscal year 1939, as compared with 117,000 miles in the previous year. The *Penguin* covered about 30,000 miles, the *Teal* 11,000 miles, and the *Crane* 9,000 miles. Owing to the accidental grounding of the *Brant* on Williams Reef on July 15, that vessel was out of commission during a considerable part of the season, and its total mileage in the fiscal year was only about 8,000 miles.

The *Penguin* made five round trips between Seattle and the Pribilof Islands, carrying personnel and emergency supplies. Interisland service also was performed, and native workmen from the Alaska Peninsula were transported to the Pribilofs to assist with sealing activities. Two trips were made to the western Aleutians in connection with sea-otter investigations and patrol.

The *Auklet*, *Kittiwake*, *Merganser*, *Murre*, and *Widgeon* were engaged in fishery protective work in southeast Alaska. The *Eider* operated in the Kodiak area, the *Ibis* at Chignik, the *Red Wing* in the Alaska Peninsula area, and the *Coot* on the Yukon River. The *Blue Wing* was on Prince William Sound and also assisted in the patrol of southeast Alaska.

The *Teal* operated on Cook Inlet, carried on the stream survey in the Prince William Sound area, and assisted in the stream survey and general patrol in southeast Alaska. The *Crane* transported per-

sonnel and supplies between Seattle and Bristol Bay and patrolled the Alaska Peninsula area. The *Scoter* was used on Bristol Bay and relieved the *Crane* in the Alaska Peninsula area for about 10 days.

The *Brant* was used in general supervisory work, chiefly in southeast Alaska, although a trip was made westward as far as Anchorage. In December this vessel transported employees of the Bureau between Seattle and points in southeast Alaska for the conduct of hearings on the Alaska fishery regulations. The *Brant* was based at Juneau for approximately 3 months at the beginning of the year to render service in connection with the biennial session of the Territorial Legislature.

The *Scoter* engaged in the fur-seal patrol in the vicinity of Neah Bay, Wash., in the spring of 1939.

The *Pelican* was engaged in exploratory trawling to determine the abundance and distribution of shrimp in the offshore waters of the Gulf of Mexico.

APPROPRIATIONS

Appropriations for the Bureau for the fiscal year aggregated $2,220,200, as follows:

Salaries, Bureau of Fisheries	$150,000
Propagation of food fishes	962,000
Construction of fish screens	20,000
Maintenance of vessels	173,000
Inquiry respecting food fishes	338,000
Fishery industries	83,600
Fishery market news service	70,000
Alaska fisheries service	270,000
Enforcement of Black Bass and Whaling Treaty Acts	17,000
Mississippi Wild Life and Fish Refuge	17,900
Fish cultural station	6,500
Travel expense	112,200
	$2,220,200

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